STANDARD OPERATING PROCEDURE

No. 4230.7C

GEOPROBE OPERATION

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APPROVED:

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TABLE OF CONTENTS

List of Attachments

1.0 PURPOSE AND APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for basic operation and application of direct-push technology (DPT) hydraulic sampling machines (e.g., manufactured by Geoprobe® Systems [Geoprobe]) and associated tooling. This equipment is designed for collection of subsurface environmental samples and application of other investigation techniques to assess subsurface conditions. Although DPT machines are now available with augering capabilities, this SOP pertains only to direct-push methodologies. Guidance and procedures outlined in this SOP are applicable for all personnel from EPA Region 7 and its contractors who utilize DPT equipment for site assessment activities in support of Region 7 programs.

2.0 SUMMARY OF METHOD

DPT rigs such as Geoprobe machines are hydraulically powered sampling devices that are generally mounted on or inside service vehicles (e.g., pickup truck, box truck, etc.) or on track-mounted frames. The DPT machine is operated by use of a hydraulic pump and powered by a gasoline or diesel engine (typically the engine for the truck or the standalone track-mounted rig). The DPT unit, fitted with a percussion hammer, is often capable of exerting over 15,000 pounds of downward force, with the weight of the vehicle/frame providing most of the force. The hydraulics push 3- to 5-foot lengths of steel rods with threaded joints into the ground. Sampling devices or direct imaging tools/attachments are typically connected to the bottom of the rod string; however, tooling may also be used to create boreholes for installation of groundwater monitoring wells or to provide conduits to suspend sensors for downhole measurements of geophysical, radiological, or chemical parameters. The rod string is advanced (pushed/hammered) by adding successive steel rods until the desired depth is reached. Carbide- and diamond-tipped drill bits and coring bits are also available for penetration of asphalt and concrete surfaces, through which the steel rods and sampling/direct imaging tools can be driven. A DPT machine provides a convenient, cost-effective, and safe means for conducting soil gas surveys, collecting subsurface soil and groundwater samples, and performing field assessments via direct imaging applications to rapidly acquire physical and/or chemical data.

3.0 DEFINITIONS

Direct Imaging Tools – These tools are driven into the subsurface by the DPT machine to acquire data such as hydraulic conductivity, electrical conductivity, hydrostatic pressure, and approximate concentrations of volatile organic compounds (VOC). Cone penetration tools are also commercially available for determination of subsurface stratigraphy and estimation of geotechnical parameters.

Direct-Push Technology (DPT) – This type of equipment utilizes a hydraulic apparatus to push/hammer successive steel rods into the ground to collect environmental samples or obtain in situ physical or chemical data.

Environmental Samples – These are samples that may be collected by use of DPT machines and specially designed tooling; environmental samples typically include soil, groundwater, and soil gas media.

4.0 HEALTH AND SAFETY WARNINGS

Health and safety issues regarding site-specific physical and chemical hazards should be addressed in Health and Safety Plans (HASP), Safe Work Practices, Job Hazard Analyses, etc. The buddy system should always be employed during DPT operations. One person is usually designated as the primary operator, and the second serves as the operator's assistant. The primary operator controls the hydraulics, and the assistant typically handles the rods and sampling/direct imaging tools. Safe operation of the DPT machine requires appropriate personal protective equipment (PPE) and other safety equipment, including the following:

- Steel-toed boots, safety glasses, hard hats, hearing protection (Occupational Safety and Health Administration [OSHA]-approved for sound levels exceeding 85 decibels [dba] is recommended), and orange safety vests should be donned by the DPT operator and assistant, as needed (and as required by the agency/company performing the DPT work).
- A first aid kit should be on site, within the vicinity of DPT operations.
- Tire blocks should be placed under the front wheels of the parked DPT vehicle to limit its movement during operation (if the DPT apparatus is mounted in a truck).
- To stabilize the DPT machine (if the DPT unit is on a track-mounted frame), outriggers should be deployed before tooling is driven into the ground.
- Care should be exercised when maneuvering the machine over rough or very wet/saturated terrain.

In addition, the following safety precautions should be observed during operation of the DPT unit:

- Always set the vehicle's parking brake before starting DPT operations.
- Never place hands on top of a rod while it is under the machine.
- The primary operator should stand to the side of the machine's controls, clear of the DPT foot and mast, while operating the controls.
- Never exert down pressure on the probe rods to lift the machine's foot more than 6 inches off the ground, as the vehicle may shift and cause injury.
- The hydraulic system and vehicle engine should be turned off before an attempt to clean or service the equipment.
- Avoid accidental engagement of the DPT machine, which may cause injury.
- Be familiar with the location of the kill switch.

Low-hanging overhead utility lines and other overhead obstructions should be avoided within the proposed work area. Buried utilities should also be located before any tooling is pushed into the ground. The state's One Call system must be notified to contact participating utility companies and request marking locations of any buried lines near the anticipated sampling areas. Coordination with all identified utility companies is critical to identify the exact location of each utility line. Private businesses may also be utilized to locate buried utilities, particularly on private properties where buried lines are often not marked by public utility companies.

Some cities may require special safety precautions during work near roadways, such as use of worker signs, flashing lights, or orange pylons. Municipal engineering departments can often provide information regarding local safety requirements. Work near railways also typically requires similar safety precautions.

5.0 CAUTIONS

The following precautions should be taken to avoid equipment damage and/or impacts on sample integrity:

- If the vehicle is parked on a loose or soft surface, do not fully raise the portion of the vehicle nearest the DPT machine's foot, as the vehicle may shift and damage the rod string/tooling.
- If a pickup truck cap (topper) is used, always extend the DPT unit out from the vehicle to clear the cap's roof line before folding the unit down to the operating position.
- Make sure all tooling is clear of the DPT apparatus when returning the mast to its storage position.
- Use caution when operating over dry grass or other combustible material, as the vehicle's exhaust system may present a fire hazard.

6.0 INTERFERENCES

Interferences associated with DPT investigations may involve cross-contamination between sampling/direct imaging locations. Sufficient decontamination of all tooling must occur after work at each location to limit potential carryover of contaminants of concern (see Section 9.3). Frequent changing of outer gloves (e.g., after work at each sampling location) should also help minimize cross-contamination of samples and/or DPT tooling.

7.0 PERSONNEL QUALIFICATIONS

A primary DPT operator must have acquired significant experience with the type of machine to be used, be familiar with the proposed sampling techniques/tooling and all relevant health and safety issues, and be knowledgeable of activities that could result in equipment damage and/or impacts on sample integrity (see Sections 4.0, 5.0, and 6.0). It is EPA Region 7 policy: a) that all EPA personnel who operate a Geoprobe shall have completed a 1-day orientation course and b) that all EPA personnel who trailer a Geoprobe shall have completed a trailering course.

DPT operators should consult state requirements regarding work at locations where the equipment will be used to determine if personal/corporate licensing or registration of the DPT unit is necessary. Such licenses/registrations and associated fees may not be required at EPA Superfund sites.

8.0 EQUIPMENT AND SUPPLIES

At a minimum, general DPT tooling typically includes 3- to 5-foot steel rods, a drive cap, and a pull cap or rod grip puller. Rod diameters generally range from 1 to 4.5 inches.

In addition to the basic operational tools, specialized sampling equipment is also required for soil, soil gas, and groundwater sampling, as well as for direct imaging applications. These specialized tools are best suited for use in certain types of physical settings and subsurface conditions. Therefore, it is imperative to know site-specific soil conditions in order to ensure that the most effective investigative techniques and equipment will be used. Other materials required for efficient DPT operation include pipe wrenches, standard and Phillips screwdrivers, various sizes and types of hammers, pliers and vice grips, wire/tubing cutters, and various types of tape (electrical, duct, Teflon®, etc.).

Development of new and improved DPT sampling equipment occurs constantly. However, the principles for use of new equipment are often fundamentally similar to those for use of existing equipment. Therefore, equipment and procedures described herein will be applicable to and sufficient for the purposes of this SOP.

9.0 PROCEDURES

Procedures discussed in this section pertain to setup and operation of DPT machines to conduct subsurface investigations.

9.1 SETUP FOR DPT OPERATION

Basic steps for setting up most DPT machines are detailed below; however, the operator's manual should be consulted for the specific DPT model being used.

1. Position the vehicle over the sampling location.
2. Set the parking brake, and then check and confirm that the vehicle is on a level surface. Because the vehicle provides the DPT machine with much of its torque, positioning the vehicle at a slight angle (with the rear of the vehicle at lowest position) increases the unit's power while providing a safe base for operation. Place tire blocks behind the front wheels of the vehicle (if applicable).
3. Open the rear truck/cap doors or remove the pickup tailgate to gain access to the DPT unit, as needed. Secure the doors so that wind or vibration will not cause them to slam shut.

4. Turn the ignition key to start the DPT machine's engine (which powers the hydraulic pump). This may be the engine of a pickup or other truck housing the DPT machine, or the engine of a track-mounted standalone rig. Switch the DPT rig's electrical control to the position that engages the clutch of the hydraulic system.

5. Extend and unfold the mast to a vertical position.

6. Move the foot down to securely rest it on the ground surface.

7. Raise the DPT mast to its maximum height, so that the lead rod and any attached sampling/direct imaging device can be inserted beneath it.

9.2 DPT OPERATION

Information regarding collection of environmental samples, use of direct imaging tools, installation of groundwater monitoring wells, and advancement of DPT tooling through hard surfaces is discussed in the following sections.

9.2.1 Soil Sampling

Tools are available to collect soil samples from discrete depths and also continuous soil cores. Sample collection is achieved by pushing/hammering a hollow, metal tube (with a cutting shoe attached to the base of the tube) into the subsurface. The tube contains a liner (polyvinyl chloride [PVC], Teflon, polyethylene terephthalate [PETG], stainless steel, brass, etc.) into which the soil is pushed within the desired sampling interval. Then, either the liner is retrieved, capped, and submitted for laboratory analysis, or the soil is removed for field evaluation and/or transfer to sample containers for laboratory analysis. Soil sampling equipment can be categorized into two primary types—single rod and dual rod systems.

Single Rod Systems

In stable soils, single rod systems may be used for open-tube sampling from the ground surface to the desired depth to collect continuous soil cores. Single rod samplers typically range in length from 2 to 5 feet, and diameters generally range from 1 to 3 inches. By this method, the open-tube sampler is repeatedly inserted into the same borehole to obtain successive cores. In unstable soils with tendency to collapse, use of single rod systems may require a stop-pin and piston rod apparatus to prevent soil from entering the sampler as it advances to the desired sampling interval; the stop-pin holds the piston and a pointed tip in place at the leading edge of the sampler. Once the desired sampling depth is reached, steel extension rods are inserted into the rod string and used to extract the stop-pin. The sampler is then driven to the bottom of the sampling interval to fill the liner with soil, as the piston and attached tip are displaced upward into the sample tube. After the sample liner has been filled, the sampler and rod string are retrieved from the borehole (Geoprobe 2011b, c).

Dual Rod Systems

Dual rod sampling systems utilize an outer series of rods to serve as a casing for the borehole, and an inner rod string that is repeatedly advanced and retrieved from the casing to collect continuous soil cores. This system limits potential for loose soils to slough from the borehole walls and cross-contaminate samples at greater depths, and also improves sampling speed (compared to single rod systems) at depths exceeding 20 feet. The smaller-diameter inner rods hold a sample liner in place as the outer casing and inner rods are driven the distance of the sampling interval. The inner rods are then retracted to retrieve the filled liner (Geoprobe 2010b, 2011a, 2013a).

9.2.2 Groundwater Sampling

Various methods may be implemented for collection of groundwater samples from unconsolidated sediments by temporary installation of specialized sampling tools. These tools are designed for installation at a desired location only until adequate groundwater can be collected; the tools are then removed, decontaminated, and reused at the next location. Groundwater sampling tools may be divided into three primary categories—protected screen, exposed/retractable screen, and specialized tools/systems.

Protected Screen Tools

This common method of groundwater sampling involves use of a wire-wound stainless steel screen or slotted PVC screen enclosed in an outer metal sheath and driven to the desired sampling depth. The screen is then exposed to the surrounding sediments by retraction of the outer sheath while extension rods hold the screen in place, allowing groundwater to flow into the screen for withdrawal by use of various collection tools (discussed later in this section). This method utilizes the outer sheath to form an annular seal above the screened interval, and is generally used to conduct sampling at a discrete depth (Geoprobe 2006b, 2010a).

Exposed/Retractable Screen Tools

For vertical profiling, wire-wound stainless steel screens or mill-slotted rods may be used to allow collection of groundwater samples at multiple depths within the same borehole. Mill-slotted rods are driven from the ground surface to the desired groundwater sampling depth(s) while in direct contact with surrounding sediments along the entire boring depth. Specialized groundwater profilers may enable use of a dual-tube system, whereby an outer series of rods are driven to the top of the desired sampling depth, and then a slotted stainless steel screen (typically no longer than 1 foot) attached to an inner rod string may be inserted into the outer casing and successively driven to greater depths while continuously exposed to the surrounding sediments. Because the screens (or slotted rods) are in direct contact with surrounding sediments during advancement to the sampling depths, this method is most suitable for use in sediments with minimal silt and clay, which can plug openings of the screens/slotted rods.

Dual rod systems for vertical profiling are also available that involve concurrently driving outer and inner rod strings (with an expendable drive point) to the top of the desired sampling interval, removing the inner rods, and inserting a PVC or stainless steel screen (typically no longer than 1 foot) attached to extension rods through the outer rod string. The outer rods are retracted while the screen is held in place to expose it to the surrounding sediments, enabling groundwater to flow into the screen for collection. After sampling, the screen is withdrawn from the borehole and replaced with the inner rods (and expendable drive point), which may be driven to the next sampling depth where the process is repeated.

Specialized Systems

Specialized DPT tools have been developed that incorporate probes with direct imaging sensors and also screened ports that enable collection of groundwater samples by use of a built-in bladder pump. These devices allow acquisition of direct imaging data (e.g., electrical conductivity, hydrostatic pressure, hydraulic conductivity, etc.) at depths where groundwater sampling may also occur by use of the same tooling. These systems also enable sampling at multiple depths within the same borehole.

<u>Groundwater Sampling Pumps, Check Valves, and Bailers</u>

Groundwater samples may be collected in conjunction with the aforementioned protected screen and exposed/retractable screen tools by use of peristaltic pumps, bladder pumps, tubing check valves, or mini-bailers—all designed to retrieve groundwater samples through DPT rods. The appropriate sampling method will depend on (1) sampling depth (e.g., peristaltic pumps are not able to retrieve groundwater at depths exceeding approximately 30 feet), (2) required sample volume (e.g., capacity of mini-bailers may be restricted to 20 milliliters), (3) contaminants of interest (e.g., if sampling for analysis for VOCs, bladder pumps may be the preferred method to limit turbulence and potential loss of analytes during sampling procedures), and (4) efficiency of available sampling options (e.g., use of tubing check valves requires minimal setup and decontamination time).

9.2.3 Soil Gas Sampling

DPT machines may ease the task of soil gas sampling to investigate subsurface contamination (Geoprobe 2006a). Notably, not all soil types are conducive to soil gas sampling. If no soils at a site are appropriate for soil gas sampling, investigators should consider collection of alternative media (soil and/or groundwater) to assess presence of contaminants. Soil gas sampling methods can be categorized into two primary tooling systems—temporary systems for grab sampling, and permanent implants to serve as repeatable sampling points.

Temporary Systems

Collection of soil gas samples most often proceeds by attaching an expendable point holder to the bottom of a rod string, inserting an expendable point, and driving the rods to the desired sampling depth. The rod string is then retracted to expel the point and expose a void space from which to collect soil gas. Polyethylene tubing is attached to a metal tubing adapter (e.g., Geoprobe Post-Run Tubing [PRT] adaptor), which is then inserted into the rod string and threaded into the expendable point holder. A vacuum pump is connected to the top end of the tubing and used to purge ambient vapors from the tubing, which is then connected to the selected sample container/media (SUMMA canister, Tedlar bag, sorbent tube, etc.). Collection of soil gas samples may also occur directly through the rod string by connecting tubing to a fitting attached to the top rod. If this technique is used, O-rings should be placed between each rod to ensure an airtight seal at each rod joint. If a pre-evacuated sample container (e.g., SUMMA canister) is used, the soil gas sample will be collected when a valve on the container is opened. Otherwise, use of a sampling pump will likely be required to enable collection of the sample.

If moist and/or fine-grained soils are encountered that prohibit soil gas sampling, the rod string may be slowly raised while a vacuum is applied to the system (either by use of a vacuum pump with an in-line vacuum gauge, or an attached SUMMA canister with a vacuum gauge) until a zone is reached that yields soil gas (as indicated by the vacuum gauge response).

Permanent Implants

Cylindrical stainless steel screens with attached tubing may be inserted through the rod string to serve as permanent/repeatable soil gas sampling points. These screens typically range in length from 6 inches to 2 feet, with pore size between 0.1 and 0.2 millimeter. Tubing for these implants may be polyethylene, Teflon, or stainless steel. After the screen has been secured to a drive point/anchor at the bottom of the rod string, the rods are removed, and the annulus of the borehole is backfilled as the top of the attached tubing is allowed to protrude above the ground surface. A porous material (e.g., glass beads) is used to backfill the annulus around the screen, while the overlying annulus is typically backfilled with a bentonite-based material. Surface completions that house the top portion of the tubing may consist of aboveground protective casings or below-grade vaults. Soil gas sampling may occur when needed, as previously described for temporary soil gas systems.

9.2.4 Direct Imaging Tools

DPT tools are available for acquiring in situ data to determine soil types, estimate concentrations of contaminants such as VOCs or petroleum-related substances, and obtain other information regarding physical/chemical characteristics of subsurface soil and/or groundwater. These direct imaging data are generally obtained by attaching probes/sensors to the DPT rod string, and driving them to depth(s) of interest. Field computers and analytical instrumentation are used to store and interpret the results. Direct imaging data may be obtained to determine the following:

Soil Type – In situ electrical conductivity measurements may be taken to interpret soil types and develop a soil profile log (Geoprobe 2008).

Hydraulic Conductivity – This may be determined from results of pneumatic slug tests (Geoprobe 2011d) or based on injection pressure data (Geoprobe 2013b). Knowledge of hydraulic conductivity can be useful in groundwater investigations for estimation of groundwater flow velocity, contaminant transport times, etc.

VOCs – Relative magnitude of VOC concentrations in the subsurface may be determined in situ by use of a downhole probe containing a heated membrane and a carrier gas that transports contaminants to analytical instruments at the surface (Geoprobe 2012).

Water Table Elevation – This may be estimated based on hydrostatic pressure measurements by use of subsurface DPT tooling (Geoprobe 2013b).

Geotechnical Parameters – These parameters, which include soil resistance and pore pressure, may be determined by use of cone penetration testing tools that have been adapted to DPT application.

9.2.5 Installation of Groundwater Monitoring Wells

DPT machines may be used to install groundwater monitoring wells by use of direct-push tooling (ASTM International 2001). Depending on the size of available tooling, well casings for DPT applications typically range from 0.5 to 2 inches in diameter, and are usually constructed of threaded PVC sections. For permanent wells, a factory-slotted PVC screen is generally used that may contain an outer mesh material to hold filter pack sand. The filter pack sand may already be included with the purchased screen (prepacked screen), or it can be added by the well installer. Multiple lengths of well screen can be screwed together to obtain the desired total length of screened interval for the well. A bottom plug (or snap lock connector) is attached to the base of the screen, the top of the screen is attached to PVC risers, and the assembly is lowered into the borehole created by advancement of DPT rods and an expendable point. As the rods are retracted, a grout barrier can be created by natural collapse of sediments above the screen, or a barrier material may be introduced through the rods. Granular bentonite or bentonite slurry is then added in the remaining well annulus to form a seal. Flush-mount or aboveground completions may be utilized to protect the top access to the well. Specific state monitoring well standards may need to be consulted.

If a DPT well is installed for temporary use only (e.g., 1-7 days), a factory-slotted PVC pipe section may be attached to PVC risers and inserted into a borehole. For this type of temporary well, introduction of filter pack and/or grout within the annulus may be optional, depending on anticipated duration of the well, nature and stability of formation materials, knowledge of contaminated soils or groundwater above the screened interval, regulatory requirements, etc. These types of wells may be beneficial if a grab sample is desired, but groundwater recharge is slow. These wells are typically removed soon after collection of groundwater samples.

9.2.6 Drilling/Coring through Hard Surfaces

A breaker or coring bit is used for penetrating concrete, asphalt, or other hard surface, such as frozen ground or hard-packed gravel. Either a diamond- or carbide-tipped bit attached to a steel shaft may be driven through the surface material to allow access to underlying soils by use of aforementioned DPT tools (Geoprobe 2000). Breaker/drill bits typically range from 2 to 4 inches in diameter, while coring bits are available up to at least 8 inches in diameter. Use of these bits requires rotation of the DPT drive assembly to turn the bit as it is lowered onto the hard surface to initiate grinding through the material. However, care must be taken to limit down pressure on the bit, as too much pressure can cause the tooling to bind and stop rotating. Also, application of water to cool the bit may be necessary to limit damage to the bit if drilling/coring occurs for an extended period of time.

9.3 DECONTAMINATION

Decontamination procedures for DPT rigs and tooling may vary, depending on the type of sampling/investigation and nature of contamination at the site. Care should be taken during the sampling process to ensure that clean or decontaminated equipment is segregated from contaminated or used equipment, so that cross-contamination does not occur. Although decontamination methods should be addressed in site-specific planning documents, general procedures for decontamination are detailed as follows:

Groundwater Samplers: The groundwater sampling sheath, rods, and reusable screens should be decontaminated by use of soap and water to remove dirt, oil, or other substances. Brushes and/or pressure washers may be used to assist with decontamination procedures. This is typically followed by a tap water and/or deionized water rinse. If sampling for VOC analysis is required, consideration may also be given to heating sampling tools after work at each location.

Soil Samplers: Use of disposable liners with soil samplers greatly reduces the amount of decontamination needed. In most instances that disposable liners are used, only the exterior of the sampler and the cutting shoe must be decontaminated (as described above for groundwater sampling tools).

Soil Gas Sampling Apparatus: Utilization of a PRT-type system for soil gas collection nearly eliminates need to decontaminate sampling equipment. Because soil gas samples are collected from an isolated source point at the base of the rod string, the only hardware items in direct contact with soil gas vapors at the sampling point are the tubing adapter and the expendable point holder. The polyethylene tubing is discarded after use at the sampling point. External decontamination typically consists of using a wire or bristle brush to remove any soil adhering to DPT rods. If soil gas sampling proceeds through the rods themselves (instead of by use of a PRT-type system), further decontamination (heating rods, etc.) may be warranted after sampling at each location.

Other Tooling: Decontamination procedures for other DPT tooling (direct imaging probes, drill bits, etc.) depend on the type of tooling, and nature and levels of suspected contamination. These decontamination procedures should be specified in a site-specific work plan and/or HASP.

9.4 BOREHOLE ABANDONMENT

All DPT boreholes should be backfilled in accordance with state regulations. At a minimum, all borehole void space should be filled with granular bentonite. Cement and/or bentonite grout slurry may be required to plug boreholes by use of a grout pump. Project managers should refer to state statutes to ensure that closure procedures comply with existing regulations.

9.5 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated from DPT activities may include environmental media (soil cores, purged groundwater, etc.), used sampling supplies (tubing, soil liners, etc.), and used PPE (gloves, Tyvek coveralls, etc.). Handling and disposal of IDW should be addressed in site-specific work plans and/or HASPs, and should consider the nature and approximate anticipated concentrations of contaminants of concern, regulatory/agency requirements, field screening data, visual observations, etc. If necessary, IDW may have to be containerized and sampled for laboratory analyses to ensure proper disposal.

10.0 DATA AND RECORDS MANAGEMENT

Permits may be required by the city, county, and/or state where DPT activities occur. Adequate time should be allotted to ensure acquisition of these permits prior to work activities. Other records such as boring logs, well registration forms (for permanent wells), and well abandonment forms may also be required by state agencies.

Documentation to accompany environmental samples may include field sheets, chain-of-custody records, and shipping airbills. Other records documenting field activities may include field logbooks and photo logs. Geographic coordinates of all sampling locations should be recorded. Electronic forms/applications may also be used to manage site-related data if approved by the user/agency. Direct imaging data are typically saved in electronic files.

11.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance/quality control (QA/QC) procedures regarding sampling-related issues should be addressed in site-specific work plans. These procedures typically apply to collection of field duplicates, field blanks, trip blanks, and/or equipment rinsate blanks to evaluate (1) reproducibility of analytical results, (2) contamination introduced during collection and transportation of samples, and/or (3) efficiency of decontamination techniques for reusable sampling tools.

If direct imaging data (e.g., electrical conductivity measurements) are used to indicate subsurface soil types across a site, collection of a few soil cores may be warranted to "standardize" the results in order to ensure correct interpretation of in situ readings. If direct imaging/field screening tools are used to evaluate subsurface VOCs or other contaminants of concern, split sampling for laboratory confirmation analysis may be warranted to compare field results with laboratory data.

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ATTACHMENT A

Summary of Changes

Version x → y	Description of Change	Justification
4230.07B to 4230.07C	Updated signature page	To reflect current organization
4230.07B to 4230.07C	Updated Section 7.0	To include requirement for completing a trailering course for all those who trailer a Geoprobe
4230.07B to 4230.07C	Added Attachment A	To track changes and provide an easily accessible history of changes for SOP users